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Title: Space Transportation System Availability Requirements and Its Influencing Attributes Relationships

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Text: It is essential that management and engineering understand the need for an availability requirement for the customer's space transportation system as it enables the meeting of his needs, goal, and objectives. There are three types of availability, e.g., operational availability, achieved availability, or inherent availability. The basic definition of availability is equal to the mean uptime divided by the sum of the mean uptime plus the mean downtime. The major difference is the inclusiveness of the functions within the mean downtime and the mean uptime. This paper will address the inherent availability which only addresses the mean downtime as that mean time to repair or the time to determine the failed article, remove it, install a replacement article and verify the functionality of the repaired system. The definitions of operational availability include the replacement hardware supply or maintenance delays and other non-design factors in the mean downtime. Also with inherent availability the mean uptime will only consider the mean time between failures (other availability definitions consider this as mean time between maintenance – preventive and corrective maintenance) that requires the repair of the system to be functional. It is also essential that management and engineering understand all influencing attributes relationships to each other and to the resultant inherent availability requirement. This visibility will provide the decision makers with the understanding necessary to place constraints on the design definition for the major drivers that will determine the inherent availability, safety, reliability, maintainability, and the life cycle cost of the fielded system provided the customer. This inherent availability requirement may be driven by the need to use a multiple launch approach to placing humans on the moon or the desire to control the number of spare parts required to support long stays in either orbit or on the surface of the moon or mars.

It is the intent of this paper to provide the visibility of relationships of these major attribute drivers (variables) to each other and the resultant system inherent availability, but also provide the capability to bound the variables providing engineering the insight required to control the system's engineering solution. An example of this visibility will be the need to provide integration of similar discipline functions to allow control of the total parts count of the space transportation system. Also the relationship visibility of selecting a reliability requirement will place a constraint on parts count to achieve a given inherent availability requirement or accepting a larger parts count with the resulting higher reliability requirement. This paper will provide an understanding for the relationship of mean repair time (mean downtime) to maintainability, e.g., accessibility for repair, and both mean time between failure, e.g., reliability of hardware and the system inherent availability.

Having an understanding of these relationships and resulting requirements before starting the architectural design concept definition will avoid considerable time and money required to iterate the design to meet the redesign and assessment process required to achieve the results required of the customer's space transportation system. In fact the impact to the schedule to being able to deliver the system that meets the customer's needs, goals, and objectives may cause the customer to compromise his desired operational goal and objectives resulting in considerable increased life cycle cost of the fielded space transportation system.